Monitoring Dynamics of the Alaska Coastal Current and Development of Applications for Management of Cook Inlet Salmon

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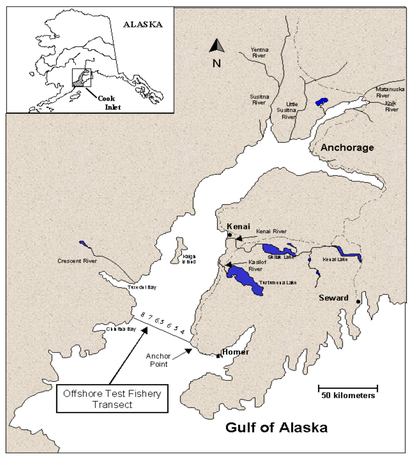
Project Major Hypotheses

- Salmon migration is delayed when fish encounter strong salinity gradients. Turbulence caused by strong tidal currents or winds breaks down salinity gradients increasing the rate of migration.

- Interannual changes in freshwater outflow from UCI or the northward extent of the ACC affect salmon migratory timing. A stronger outflow or reduced northward flow of the ACC delays the migration, as salmon require more time to acclimate at frontal zones.

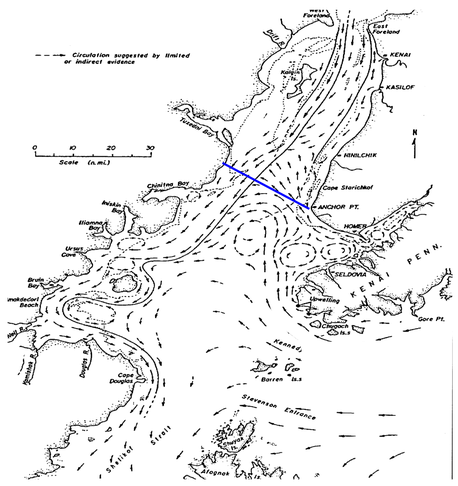
- When salmon abundance is low (high), relative salmon density is more contagiously (homogeneously) distributed. Strongly (weakly) developed tide rips cause salmon density to be more contagiously (homogeneously) distributed.

- Salmon use tidal currents in UCI to facilitate their northward migration. On the flood tide, salmon density is highest between the west and mid rips where current speeds are maximum. On the ebb tide, salmon density is highest immediately east of the mid rip and west of the west rip where turbulence reduces the net southward flow.



Net Surface Circulation in Cook Inlet during Summer

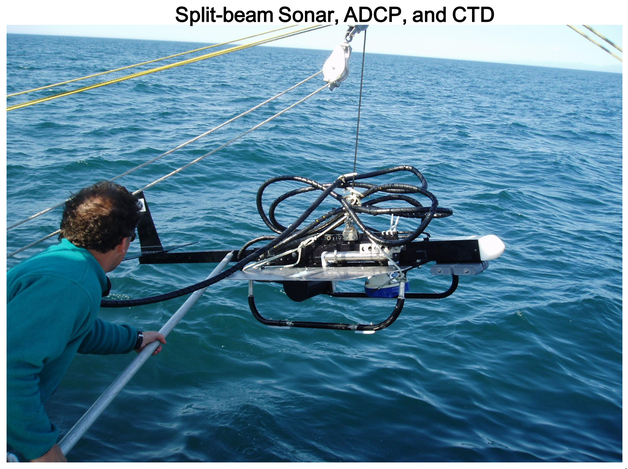
(Burbank 1977)



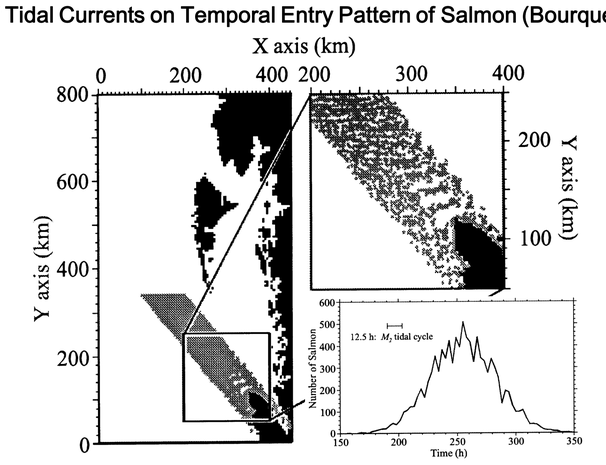
Project Field Sampling Protocols

1. Conduct an offshore test fishing (OTF) program to estimate the population size of sockeye salmon returning to Upper Cook Inlet.
2. Measure the horizontal distribution of relative salmon density along the OTF transect using side-looking acoustic equipment.
3. Measure environmental variables as well as the vertical distributions of temperature and salinity along the OTF transect and construct cross sections.
4. Measure the vertical distribution of current velocity along the OTF transect using an acoustic doppler current profiler (ADCP) and construct cross sections.

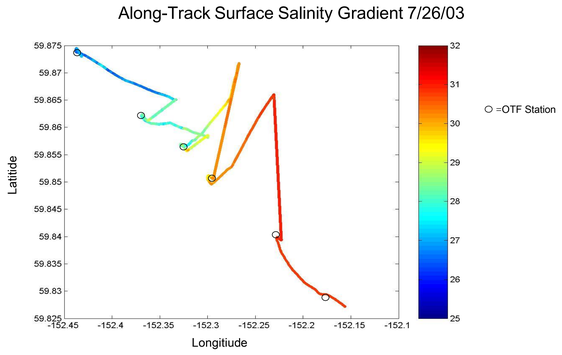
TOWBODY– Scientific instruments attached include:
Split-beam Sonar, ADCP, and CTD



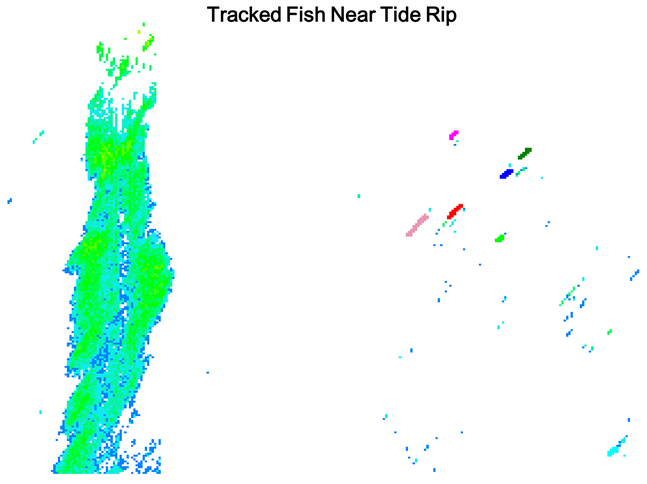
Effect of Tidal Currents on Temporal Entry Pattern of Salmon (Bourque et al. 1999)

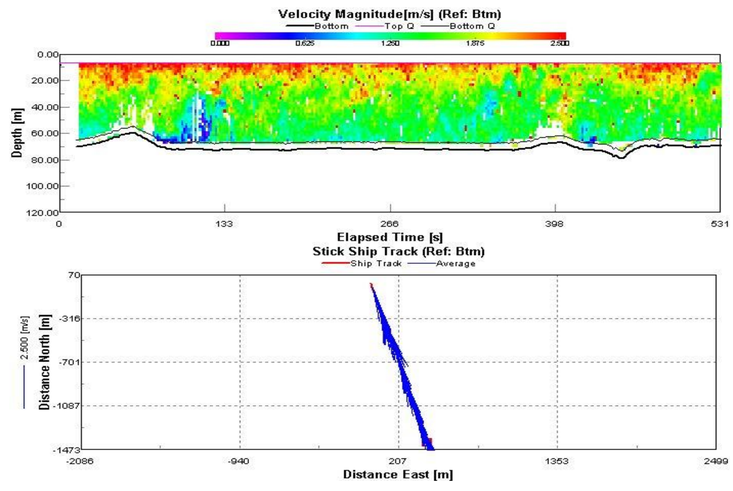


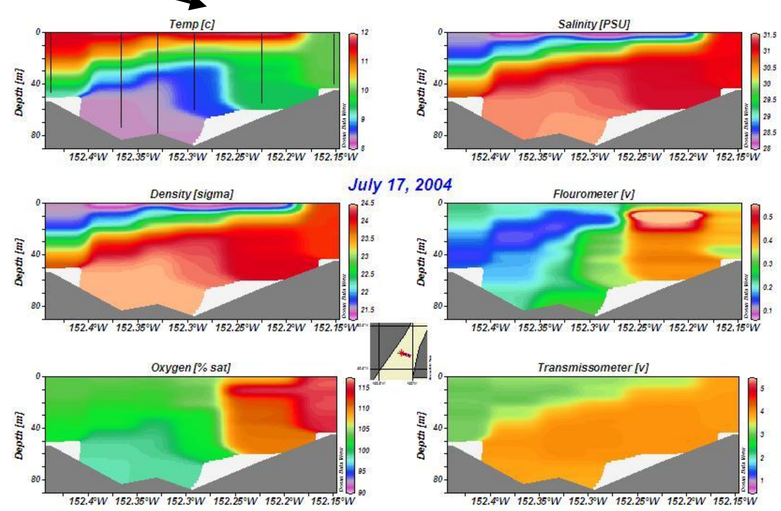
Along-Track Surface Salinity Gradient 7/26/03

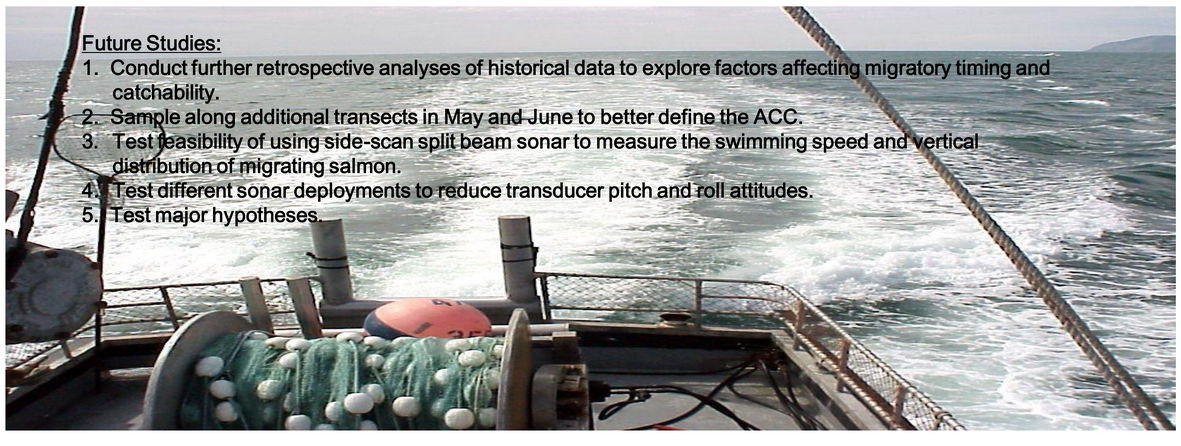


Tracked Fish Near Tide Rip









Future Studies:

1. Conduct further retrospective analyses of historical data to explore factors affecting migratory timing and catchability.
2. Sample along additional transects in May and June to better define the ACC.
3. Test feasibility of using side-scan split beam sonar to measure the swimming speed and vertical distribution of migrating salmon.
4. Test different sonar deployments to reduce transducer pitch and roll attitudes.
5. Test major hypotheses.

References:

Bourque, M-C., LeBlond, P.H., and Cummins, PF. 1999. Effects of tidal currents on Pacific salmon migration: results from a fine-resolution coastal model. Can. J. Fish. Aquat. Sci. 56: 839–846.

Burbank, D.C. 1977. Circulation studies in Kachemak Bay and lower Cook Inlet, Environmental Studies of Kachemak Bay and lower Cook Inlet, L.L. Trasky et al. (eds) Marine/coastal habitat management report, Alaska Dept. Fish and Game, Anchorage, Alaska

Schlitzer, R., Ocean Data View, http://www.awi-bremerhaven.de/GEO/ODV,2004